May 9, 1933. J. B. HODTUM 1,907,542

GROUNDING SWITCH MECHANISM

Filed May 16, 1932 3 Sheets-Sheet 1

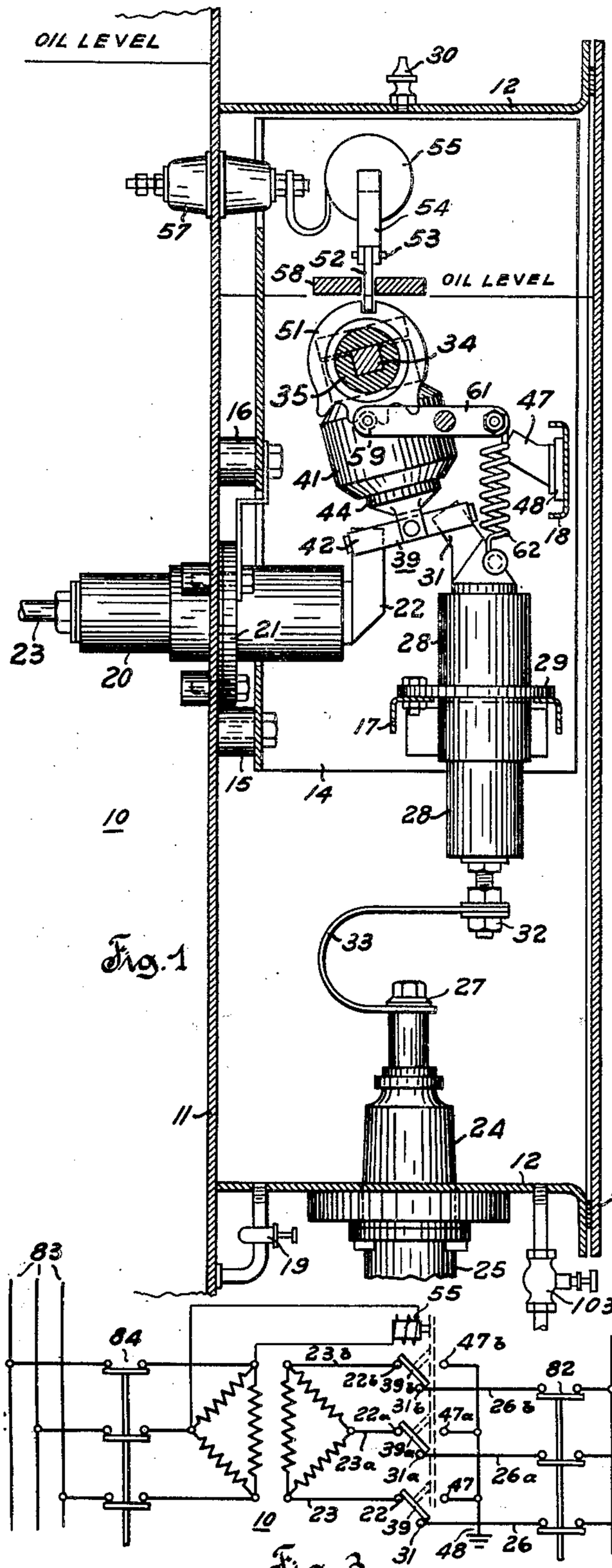

Fig. 1

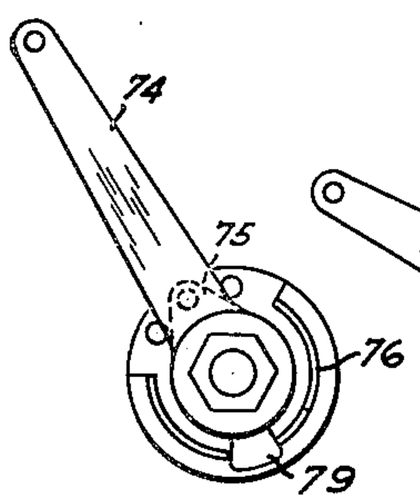

Fig. 6

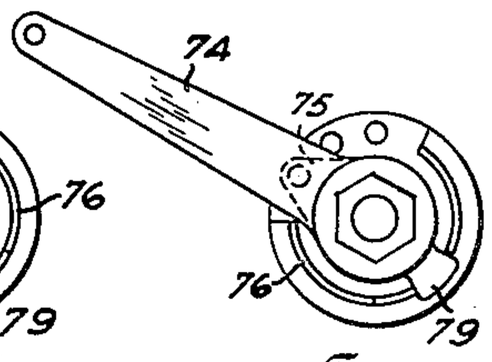

Fig. 7

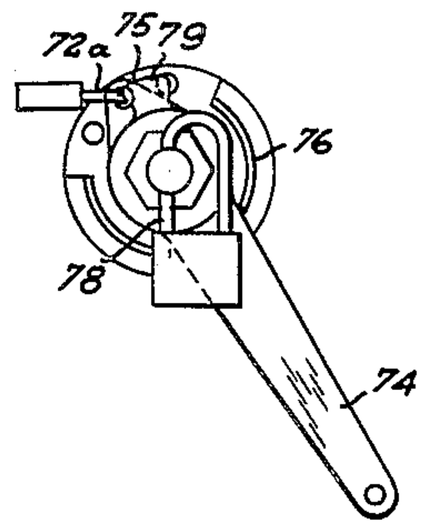

Fig. 5

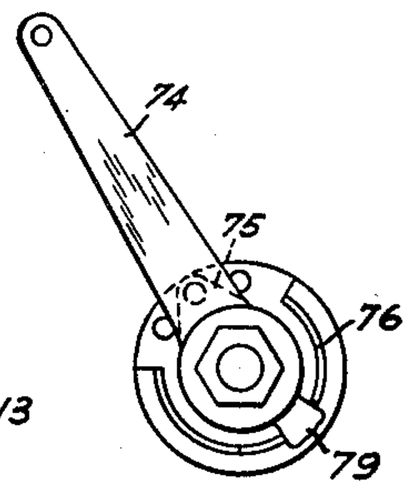

Fig. 8

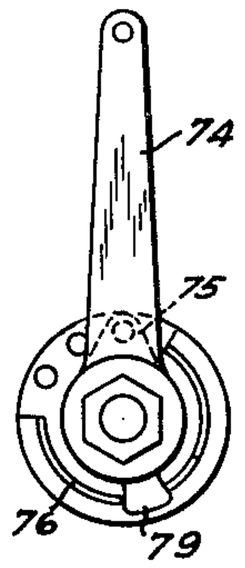

Fig. 9

Inventor
J. B. Hodtum
by
Attorney

May 9, 1933. J. B. HODTUM 1,907,542

GROUNDING SWITCH MECHANISM

Filed May 16, 1932 3 Sheets-Sheet 2

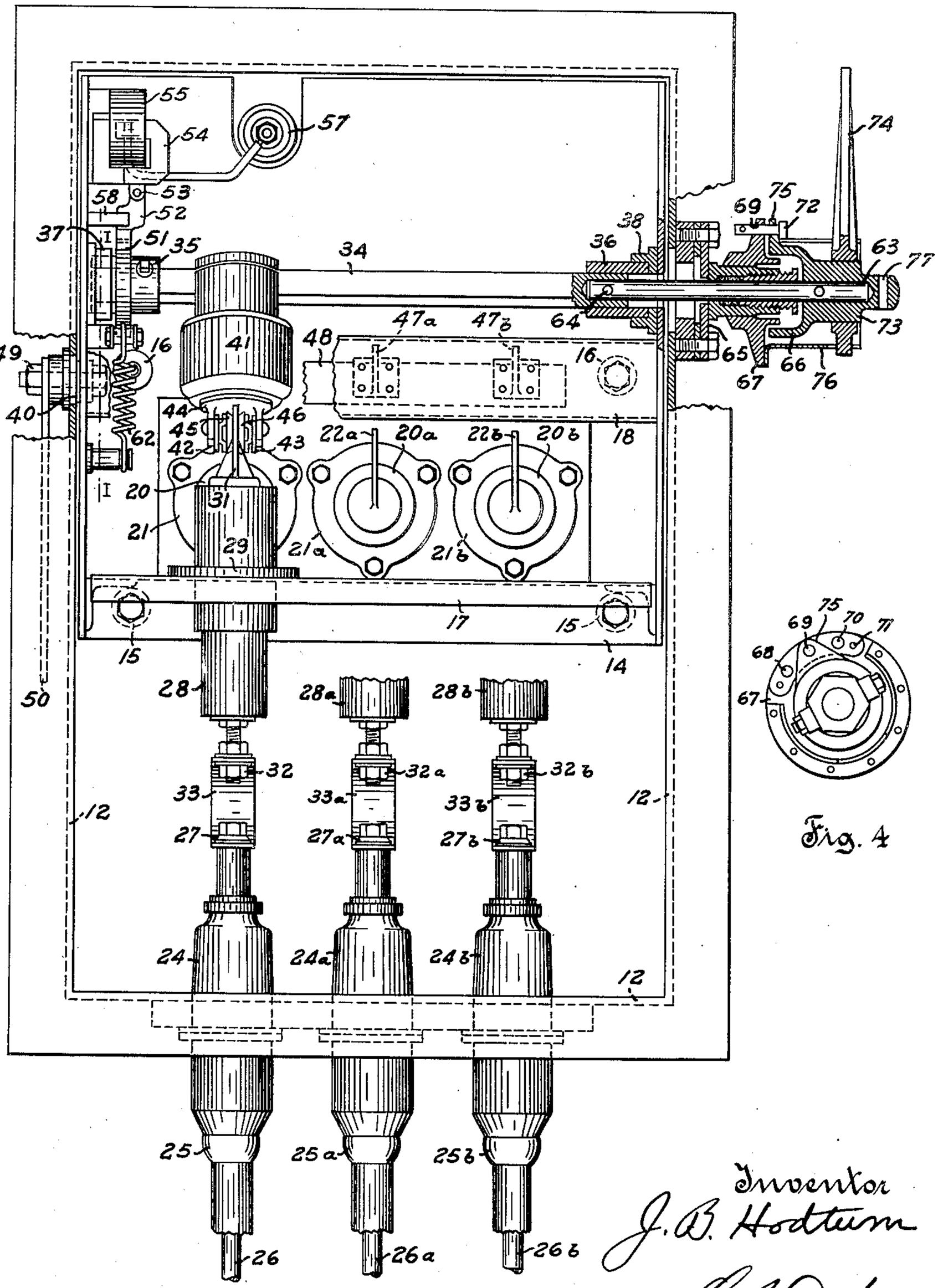

Fig. 2

Fig. 4

Inventor
J. B. Hodtum
by G. F. Delvin
Attorney

May 9, 1933. J. B. HODTUM 1,907,542

GROUNDING SWITCH MECHANISM

Filed May 16, 1932 3 Sheets-Sheet 3

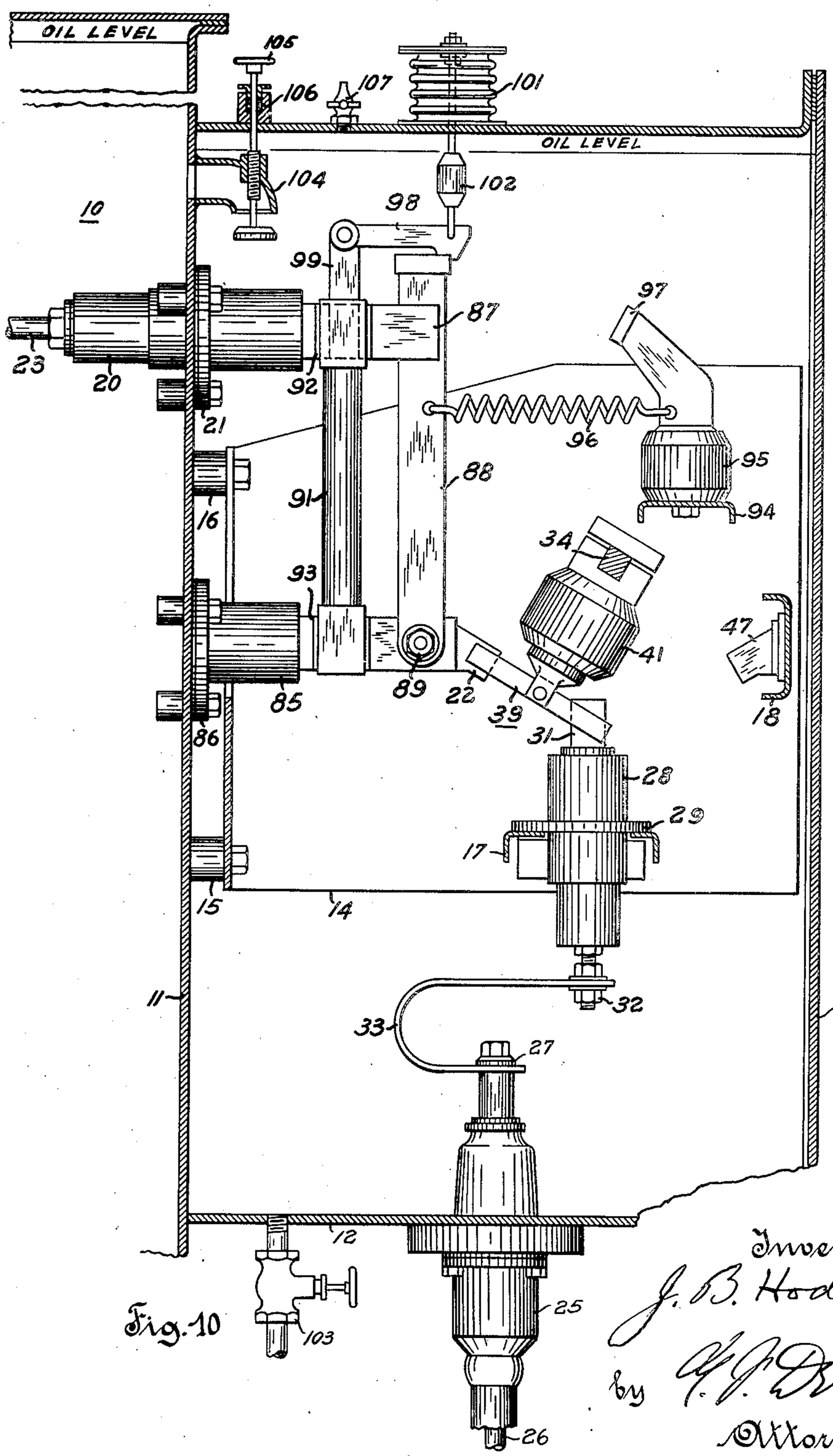

Fig. 10

Inventor
J. B. Hodtum
by C. J. Wilson
Attorney

Patented May 9, 1933 1,907,542

UNITED STATES PATENT OFFICE

JOSEPH B. HODTUM, OF BELLEVUE, PENNSYLVANIA, ASSIGNOR TO ALLIS-CHALMERS MANUFACTURING COMPANY, OF MILWAUKEE, WISCONSIN, A CORPORATION OF DELAWARE

GROUNDING SWITCH MECHANISM

Application filed May 16, 1932. Serial No. 611,459.

This invention relates in general to grounding switches and more particularly to an improved switch especially adapted to disconnect a transformer from a line and to ground the line.

In systems wherein electrical energy is transmitted to and from transformers by means of high tension lines or cables it is customary to employ switches to disconnect both ends of the transmission line when repairs are to be made on the system, and to arrange at least one of these switches so that the line may be grounded in order to protect the workmen. It has been proposed to use electromagnetically actuated locking devices energized from the transformer to prevent the accidental grounding of the line while the line is still energized.

An object of the present invention is to provide a grounding switch which may be mounted in a compartment attached to the side wall of a transformer.

Another object of this invention is to provide an improved multi-position switch, the main elements of which may be removed from a stationary casing enclosing the main elements.

Another object of this invention is to provide an improved switch operating mechanism which is simple, effective and foolproof.

A further object of this invention is to provide a switch device enclosed in a compartment which is in communication with the casing of a transformer and has mechanism responsive to abnormal conditions in the transformer for causing the actuation of the switch device.

A still further object of the invention is to provide a combined grounding switch and circuit breaker responsive to abnormal pressure within a casing.

These and other objects and advantages are attained by this invention, various novel features of which will be apparent from the description and drawings herein, and will be more particularly pointed out in the claims.

An illustrative example of the application of this invention is shown in the accompanying drawings in which:

Fig. 1 is a side view of a transformer with switch mechanism embodying the present invention attached thereto;

Fig. 2 is a front elevation of the switch mechanism shown in Fig. 1 with a portion of the switch operating mechanism in section;

Fig. 3 is a diagrammatic representation of the circuit relations of a system utilizing the switch mechanism of the present invention;

Fig. 4 is a side view of a portion of the switch operating mechanism shown in Fig. 2;

Figs. 5, 6, 7, 8 and 9 are side views of a portion of the switch operating mechanism in various positions; and

Fig. 10 is a side view of a switch mechanism similar to that shown in Fig. 1 and embodying additional features of the present invention.

Referring now to Figs. 1 and 2, the casing 11 of transformer 10 has attached thereto the side walls 12 of a switch casing. A removable cover 13 is suitably attached to a flanged portion of side walls 12 with a fluid-tight gasket therebetween. A U-shaped switch frame 14 is bolted to the spacing pads 15 and 16 which are welded to the side walls of casing 11. Longitudinal members 17 and 18, preferably of channel section, are attached at each end to the side portions of switch frame 14 and serve, among other things, as stiffening members for switch frame 14. Oil from the main transformer casing may be admitted to the switch compartment by opening valves 19 and 30 until the oil rises to the desired level as indicated by a suitable oil gauge. Oil may be drained from the switch compartment by opening only drain valve 103 and valve 30. Primary bushings 20, 20*a* and 20*b* extend through apertures in casing member 11 and are attached thereto by any suitable clamping device, such as clamping rings 21, 21*a* and 21*b*, and are also provided with oil-tight gaskets. Contact members 22, 22*a* and 22*b* are carried by primary bushings 20, 20*a* and 20*b* and are electrically connected to the primary windings of the transformer 10 by means of conductors 23, 23*a* and 23*b*. Pothead bushings 24, 24*a* and 24*b* extend through apertures in the

bottom of switch casing 12 and are provided with wiping sleeves 25, 25*a* and 25*b* which are suitably attached to a base portion of switch casing 12. Line conductors 26, 26*a* and 26*b*, which are preferably lead covered cables, are electrically connected to terminal members 27, 27*a* and 27*b*. Line bushings 28, 28*a* and 28*b* extend through apertures in channel member 17 and are attached thereto by suitable clamping means, such as ring members 29, 29*a* and 29*b*. Line contact members 31, 31*a* and 31*b* are carried by line bushings 28, 28*a* and 28*b* and are electrically connected to terminal members 32, 32*a* and 32*b*, which are in turn connected to terminal members 27, 27*a* and 27*b* by means of detachable, flexible connectors 33, 33*a* and 33*b*. A rotatable switch member comprises a square shaft 34 to which collar members 35 and 36 are attached at either end. Collar members 35 and 36 are suitably journaled in stationary bearing members 37 and 38 which are welded to the side portions of switch frame 14. Three pairs of contact finger assemblies 39, 39*a* and 39*b* are carried by insulator members 41, 41*a* and 41*b*, which are suitably attached to shaft member 34, noting that the latter two contact finger assemblies and insulators have been omitted from the drawings in order to more clearly show the contacts which they would otherwise cover. Each contact finger assembly comprises a pair of blades 42 and 43, each connected to a jaw of a supporting member such as 44. Each contact blade carries at each end thereof a contact member such as 45 and 46 which are adapted to be resiliently pressed into engagement with the opposite sides of the various stationary contacts. Ground contacts 47, 47*a* and 47*b* are mounted on a copper grounding strap 48 which is carried by channel member 18 and is electrically connected to ground strap 50 by means of a bolted connection which comprises bolt 49 and a spacing washer 40 interposed between switch frame 14 and casing side wall 12. This connection provides a low resistance path for current to ground, noting that this connection may be broken by removing bolt 49 when it is desired to remove the switch frame 14 from the switch casing 12.

In order to prevent movement of shaft 34 only when the transformer is energized, an electromagnetic locking device is provided which comprises a notched wheel 51, which is preferably a part of collar member 35, and also a detent pawl 52 which is pivoted at 53 and carries an armature 54. Armature 54 is adapted to be held in the position shown when coil 55 is energized. Coil 55 is connected across a low voltage winding 56 of the transformer or across an auxiliary winding on the core of the transformer. When coil 55 is deenergized, gravity or a spring will cause armature 54 to rotate in a clockwise direction about pivot point 53 to withdraw detent pawl 52 from the notch in wheel 51. Current for energizing coil 55 is conducted through casing 11 of the transformer by means of one or more bushings such as 57, noting that if one conductor of the low voltage transformer winding is grounded to the transformer casing the casing may be used as one conductor, in which event only one bushing is necessary. A notched member 58 is attached to switch frame 14 and serves to prevent rotative forces from being transmitted from shaft 34 to pivot 53. Notched wheel 51 also has a plurality of depressed portions into which a roller member 59 is adapted to be pressed by means of pivoted lever 61 and spring 62, for the purpose of resiliently retaining the rotatable contacts in their proper positions.

The right hand end of shaft 34 is bored to receive operating rod 63, noting that detachable pin 64 connects collar member 36, shaft 34 and operating rod 63 together. Operating rod 63 is carried by a flanged stuffing box 65 which is bolted to the side wall of switch casing 12 with a gasket interposed therebetween. A gland 66 permits the stuffing box to be tightened. A collar member 67 is preferably keyed to the stuffing box member 65, however, it may be integral therewith. Collar member 67 is provided with holes 68, 69 and 70 (noting Fig. 4) adapted to receive pin 72 or the hasp of a padlock 72*a*, and an escutcheon plate 71 may be mounted over holes 68, 69 and 70 with suitable legends such as "Off", "Trans." and "Ground" respectively thereon. Thimble member 73 is pinned or otherwise suitably fastened to shaft 63 and is provided with a hexagonal portion adapted to receive operating wrench 74. Thimble member 73 is also provided with a lug portion 75 with a hole therein adapted to receive pin 72 or the hasp of a padlock 72*a*. A flanged sleeve 76 is attached to flange collar 67, noting that these parts may be integral if so desired. Thimble member 73 is provided with a hole 77 adapted to receive the hasp of a padlock 78. Flanged sleeve 76 is provided with cut-away portions which limit the movement of lug 79 and wrench 74 for a purpose to be hereinafter described.

When it is desired to remove the switch mechanism from the switch casing 12 it is only necessary to drain the oil from the switch compartment, remove cover plate 13, remove bolt 49 of the ground connection, remove bolts 15 and 16, disconnect coil 55 and links 27, 27*a* and 27*b*, remove pin 64, and withdraw operating rod 63 to the right. The switch mechanism may then be withdrawn from the casing as a unit and repaired or a new unit substituted.

The operation of the present invention is best shown by first referring to Fig. 3 where-

in 81 represents a source of power and 82 represents a circuit breaker usually located at a sub-station for controlling the energization of feeder conductors 26, 26*a* and 26*b*. With the switch in the position shown in this figure, the conductors 26, 26*a* and 26*b* are connected to primary leads 23, 23*a* and 23*b* of a transformer 10. The secondary windings of transformer 10 are connected to a network load circuit 83 by means of a network circuit breaker 84 which is automatically operable in response to various voltage and current conditions of the circuits. Coil 55 of the electromagnetic interlock is shown as connected across the secondary terminals of transformer 10. The primary and secondary windings of transformer 10 are shown connected in delta, however, it is to be understood that either one or both of the windings may be connected in star. If it is desired to make repairs on line conductors 26, 26*a* and 26*b*, circuit breaker 82 will be opened and locked in its open position, thereby causing circuit breaker 84 to automatically open in a manner well known in the art. With both primary and secondary windings of transformer 10 deenergized, coil 55 will be deenergized so that detent pawl 52 is caused to move out of the notch in wheel 51.

With the switch mechanism in position shown in Fig. 1 the transmission line conductors 26, 26*a* and 26*b* are connected to the primary windings of the transformer 10. The switch mechanism may be locked in this position by placing operating wrench 74 in the position shown in Fig. 5 and passing the hasp of padlock 78 through hole 77, noting that flanged sleeve member 76 thus prevents movement of operating wrench 74. Padlock 72*a* may also be passed through the hole in lug 75 and hole 69 to doubly insure the retention of the switch mechanism in the position shown in Fig. 1. If it is desired to disconnect the transformer from the line conductors without connecting the line conductors to ground, it is necessary that both padlocks 72*a* and 78 be removed in order that wrench 74 may be removed and then replaced as shown in Fig. 6, thus permitting wrench 74 to be moved to the position shown in Fig. 7, providing coil 55 is deenergized. It is to be noted that lug portion 79 on wrench 74 limits the range of movement of the wrench to either the transformer energized position or the open position in which the line is disconnected from the transformer, but not grounded. Padlock 78 may then be locked in hole 77 to insure that the switch may only be moved to and from the "Off" and "Trans." positions, provided coil 55 is deenergized. If it is desired to ground the feeder line, padlock 78 may be removed and wrench 74 turned over so that lug portion 79 engages the right hand edge of the notch in sleeve 76, as in Fig. 8, instead of the left hand edge, as in Fig. 6. With the wrench placed on a thimble as thus described, it is possible to rotate this wrench in a clockwise direction so as to electrically connect contacts 31, 31*a* and 31*b* with ground contacts 47, 47*a* and 47*b*, respectively, provided the coil 55 is deenergized. Padlock 78 may then be locked in hole 77 to insure that the switch may only be moved to and from the "Trans." and "Ground" positions. It is thus seen that wrench 74 may be locked on thimble 73 so that only two of the three switch positions may be obtained and that with the operating wrench locked on the thimble in a different manner that only a third switch position and one of the former positions may be obtained. It is to be noted that the switch may be locked by padlock 72*a* in any one of the three positions. It is thus possible to guard against improper operation of the switch and to prevent movement to the "Off" position or the "Ground" position without going through the "On" position. With this mechanism it is also impossible to operate the switch from the "Off" position to the "Ground" position so rapidly that the interlock does not have time to function to prevent the grounding of the feeder line if it is energized.

Referring now to Fig. 10, a switch compartment substantially the same as that described in connection with Figs. 1 and 2 is shown attached to the side wall 11 of the transformer 10. The ground switch mechanism is substantially the same as that hereinabove described except that switch contacts 22, 22*a* and 22*b* are not directly connected to transformer lines 23, 23*a* and 23*b*, but are connected thereto through fuses and switch blades as will appear more in detail hereafter. Inasmuch as Fig. 10 is a side view, it shows only one of each set of contacts and bushings, however, it is to be understood that an elevation view similar to Fig. 2 would show the other contacts in substantially the same manner as shown in Fig. 2. Contact 22 is carried by insulator 85 which is attached to side wall 11 by means of a clamping device 86. Bushing 20 carries a contact member 87, which is adapted to be engaged by blade 88 of a threepole switch which is pivotally connected to support 89. A fuse 91, preferably of the carbon tetrachloride filled type, is connected across the contacts 87 and 89 by means of clips 92 and 93. A channel member 94 is suitably attached to the opposite sides of switch frame 14 and carries a bushing 95. A spring member 96 is connected between the switch blade 88 and stop member 97, noting that when three switch blades such as 88 are used, spring 96 is preferably connected to the middle blade in order that the biasing force thereof may be equally transmitted to the other blades through the insulating cross member. A latch member 98 is carried by a support 99, which is at-

tached preferably to the middle contact corresponding to contact 87. Latch member 98 is adapted to be moved upwardly by sylphon bellows 101 upon occurrence of abnormal pressure within the switch compartment, noting that insulator 102 is provided for insulating latch member 98 from the switch casing. Valve 103 is provided in the bottom of the switch compartment for the purpose of draining the oil from this compartment and for removing the carbon tetrachloride which may be ejected from the fuses. A valve 104, which is operable by means of handle 105 extending through stuffing box 106, provides a communicating path between the main transformer casing and the switch compartment when open. The switch compartment may be filled with oil by closing valve 103, opening vent cock 107, and opening valve 104, and when the oil level in the switch compartment rises to the desired value, the vent cock 107 may then be closed. In some instances it may be desirable to leave an air space above the oil in the switch compartment.

The operation of Fig. 10 is as follows: Upon occurrence of a fault in the windings of transformer 10 or upon excessive temperature therein, pressure, due to the expansion of the oil or the formation of gas, will be transmitted to the switch chamber, preferably through open valve 104, or from the gas space above the oil in the main tank to the gas space above the oil in the switch compartment through a conduit therebetween, thereby causing sylphon bellows 101 to rise and release latch 98. The connection between the sylphon bellows 101 and the latch 98 may be adjusted so that the switch is not tripped due to the ordinary expansion of the oil during normal operation. Upon release of latch 98, spring 96 will act to move the multiple switch having blade 88 to an open position, thereby permitting the full line current to pass through fuses 91, etc. These fuses are preferably of such capacity as to be capable of carrying currents only slightly above the magnetizing currents of transformer 10, and consequently, these fuses will blow when the switch having blade 88 is opened, thereby disconnecting the transformer from the transmission line. Although it is preferable to use a sylphon bellows to trip the fuse shunting switch it is to be understood that this switch may be tripped in response to other abnormal conditions such as excessive temperature and differential current.

The network breaker between the secondary windings and the network load circuits will then be caused to open by means of network protective apparatus well known in the art and will thus prevent the transformer windings from being energized from the network load circuit. Although it is preferred that the feeder circuit to the primary windings be broken by means of fuses of low capacity it is to be understood that the fuses may in some instance be omitted in which event the circuit will be broken by the oil immersed switch.

The above described embodiment of the invention is specific to a three pole grounding switch particularly adapted for three phase service, but it is to be understood that the invention may be utilized where more or less than three conductors are used.

It is to be understood that the present invention is not limited to the specific details shown, since various modifications may be made in the various elements without departing from the spirit and scope of the invention as defined in the appended claims.

It is claimed and desired to secure by Letters Patent:

1. A grounding switch comprising a plurality of sets of stationary contacts in arcuate alignment, a set of movable contacts operable to one position to bridge two sets of said stationary contacts respectively and operable to another position to bridge another set of said sets of stationary contacts and one of said two sets of said stationary contacts respectively, means operable by rotational movement only for actuating said set of movable contacts to said positions, and an electromagnetically actuated locking device operable when energized to prevent actuation of said actuating means.

2. A grounding switch comprising three sets of stationary contacts, means for holding the first set of said stationary contacts in spaced electrically connected relation and for holding the second and third set of said stationary contacts in spaced relation insulated from each other and from the first set of said contacts, a set of movable bridging contacts, means operable to a plurality of positions by rotational movement only for causing said bridging contacts to selectively bridge adjacent sets of said stationary contacts respectively, and an electromagnetically actuated locking device operable when energized to prevent the operation of said last mentioned means from one position only.

3. In combination, a casing having a detachable cover, a switch frame removably mounted within said casing, a plurality of stationary switch contacts mounted on said casing, a plurality of stationary switch contacts mounted on said switch frame, a plurality of switch contacts rotatable to selectively engage said stationary switch contacts, and operating mechanism carried on said casing for operating said rotatable switch contacts.

4. In combination, a casing having a detachable cover, a switch frame within said casing and removably attached to said casing independent of said cover, a plurality of stationary switch contacts mounted within

and carried by said casing, a plurality of stationary switch contacts mounted within said casing and carried by said switch frame, rotatable switching means arranged for selective engagement with said stationary switch contacts and rotatably carried by said switch frame, and means carried by said casing for operating said switching means.

5. In combination, a casing having a detachable cover plate, a U-shaped switch frame removably mounted within said casing, a plurality of sets of stationary switch contacts mounted on said switch frame, a rotatable operating member journaled in the opposite sides of said U-shaped switch frame, a set of switch contacts carried by said operating member and arranged to selectively engage said plurality of sets of stationary contacts, and means carried by said casing and detachable from said operating member for rotating said operating member.

6. In combination, a casing having a detachable cover plate, a U-shaped switch frame removably mounted within said casing, a plurality of sets of stationary switch contacts mounted on said switch frame, a rotatable operating member journaled in the opposite sides of said U-shaped switch frame, a set of switch contacts carried by said operating member and arranged to selectively engage said plurality of sets of stationary contacts, means carried by said casing and detachable from said operating member for rotating said operating member, and an electromagnetic lock operable when energized to prevent rotation of said operating member.

7. In combination, a casing having a side wall, a switch casing attached to said side wall and having a detachable cover, a switch frame mounted within said switch casing, a plurality of bushings extending through said side wall into said switch casing, a plurality of bushings carried by said switch frame, a switch contact mounted on each of said bushings, a plurality of switch contacts carried by said switch frame and electrically connected therewith, an operating member journaled in said switch frame, a plurality of bushings attached to said operating member, a bridging contact mounted on each of said last mentioned bushings, and a handle carried by said casing for rotating said operating member.

8. A grounding switch comprising a casing, a plurality of sets of stationary contacts, a rotatable operating means, a set of contacts carried by said means and operable to three positions to selectively engage said sets of stationary contacts, a reversible wrench member detachably connected with said operating means, and means carried by said casing for limiting the rotational movement of said operating means to two of said three positions when said wrench is connected with said operating means in one sense, and for limiting the rotational movement of said operating means to another two of said three positions when said wrench is connected with said operating means in a reverse sense.

9. A switch comprising a casing, a plurality of sets of stationary contacts within said casing, a rotatable shaft having a polygonal portion extending outside said casing, a set of rotatable contacts carried by said shaft and operable to three positions to selectively engage said sets of stationary contacts, an operating wrench member detachably carried by said polygonal portion, and means for preventing the operation of said rotatable contacts to more than two of said three positions.

10. Switch mechanism comprising a casing, a plurality of sets of stationary contacts within said casing, a set of rotatable contacts, a rotatable shaft carrying said set of rotatable contacts and operable to first, second and third positions to cause said rotatable contacts to selectively engage said sets of stationary contacts, and means for selectively limiting the rotation of said shaft to said first and second positions or to said second and third positions.

11. Switch mechanism comprising a casing, a plurality of sets of stationary contacts within said casing, a set of rotatable contacts, a rotatable shaft carrying said set of rotatable contacts and operable to first, second and third positions to cause said rotatable contacts to selectively engage said sets of stationary contacts, and means comprising a detachable wrench member for permitting operation of said shaft only to said first and second positions, when connected to said shaft in one sense and permitting operation of said shaft only to said second and third positions when connected to said shaft in a reverse sense.

12. Switch mechanism comprising a casing, a plurality of sets of stationary contacts within said casing, a set of rotatable contacts, a rotatable shaft carrying said set of rotatable contacts and operable to cause said rotatable contacts to selectively engage said sets of stationary contacts, a multiple blade switch biased toward an open position and connected with one set of said sets of stationary contacts, a latch for holding said switch in its closed position, and means responsive to abnormal pressure within said casing for tripping said latch.

13. In an electrical apparatus having an air-tight casing, the combination of an air-tight switch compartment attached to said casing and in communication therewith, a grounding switch mounted within said compartment and comprising a plurality of sets of stationary contacts and a set of movable

contacts rotatable into selective engagement with said stationary contacts, a multiple blade switch biased toward an open position and connected with one of said sets of stationary contacts, a latch for normally holding said switch in its closed position, a plurality of fuses normally shunted by said multiple blade switch, and means responsive to abnormal pressure within said casings for tripping said latch to disconnect said multiple blade switch from in shunt with said fuses.

In testimony whereof, the signature of the inventor is affixed hereto.

JOSEPH B. HODTUM.